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(54) **Vent for vehicle tire inflation system.**

(57) A tire pressure control system (10) for wheels (28) of a vehicle. The system includes an air control circuit (40) having a positive pressure air source (42), a vacuum pressure air source (44), a central control unit (46), a vehicle speed sensor (47), and a command/display console (48). The control circuit (40) includes valves (62, 64, 66, 68, 70) and a conduit assembly (74) for controlling communication of the positive and vacuum pressure air to wheel valve assemblies (14) mounted on each wheel. A vent valve (86) provides quick venting of positive air pressure in the conduit assembly (74) for effecting rapid closing of a valve device (100) in each wheel valve (14). Each wheel valve also includes a valve device (104) providing substantially unrestricted air flow from the conduit assembly (74) to the wheels when valve device (100) is open and providing restricted air flow from the wheels to the conduit assembly (74) to ensure closing of the valve device (100) when the conduit is vented.

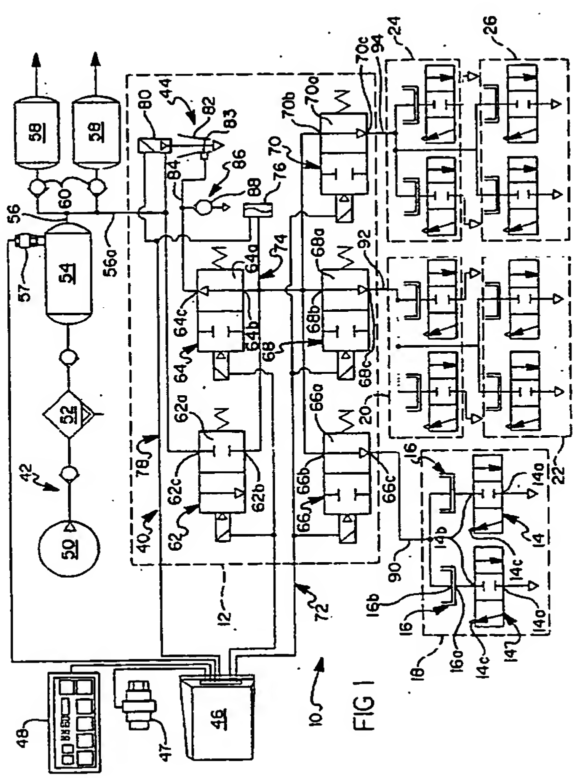

FIG 1

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cordance with ECU 46 programming. The vehicle operator has the capability of commanding the system to decrease or increase tire pressure of selected axles for respectively improving tire traction or increasing load carrying capacity of the vehicle by merely pushing the appropriate switch or command/display console 48. The system automatically increases tire pressure if the vehicle speed exceeds a predetermined speed for the selected tire pressure, and alerts the vehicle operator of tire pressure leakage and of system malfunction. The microprocessor-based ECU 46 is readily programmed by known methods to perform pressure check sequences and inflate/deflate sequences in accordance with basic algorithms.

When the vehicle ignition is energized and pressure switch 57 is closed, ECU 46 initiates a pressure check sequence of the tires on each of the axles. If tire pressure of any of the axles is found to be a predetermined amount less than command pressure, an inflation sequence is initiated for the axle or axles effected. During vehicle operation, the ECU automatically initiates periodic pressure check sequences. When enhanced or maximum traction is required, the vehicle operator may command reduced tire pressure for all or selected axles by pushing appropriate switches on the command/display console 48; if the vehicle speed is greater than a predetermined amount for the selected reduced pressure, the ECU will not initiate the appropriate pressure deflation sequence.

With control valves 62,64, axle distribution valves 66,68,70 and wheel valves 14 in the positions of Figure 1 and with vacuum source solenoid valve 80 closed, conduit assembly and each of the rotary seals 16 are vented to atmosphere through vacuum generator 82 and vent vane 86 via control valve 64 and vacuum 84.

Since pressure check and inflation/deflation sequences are basically the same for the tires on the steer, drive and trailer axles, description of the sequences for the steer axle should suffice for all of the axles. With reference first to Figure 2 and then to Figure 4. the pressure check sequence is initiated for the steer axle by energizing valves 64,68,70 to the dosed positions and momentarily energizing control valve 62 to the open position to provide positive air pressure sufficient to move the valving means of wheel valve assemblies 14 to the open positions of Figure 2. De-energization of control valve 62 returns the valving member thereof to the closed position. With valve 62 closed and valves 66,14 open, the pressure in manifold soon equalizes to tire pressure. The ECU reads this pressure via electrical signals from sensor 76 and initiates inflate/deflate sequences as required. If no further sequence is required, control valve 64 is de-energized by the ECU to effect its open position, thereby connecting the wheel valve assembly inlet ports to the vent through vacuum generator 82 and vent valve 86. Vent valve 86 provides a substantially greater flow area path to atmosphere than does orifice 83, thereby providing rapid reduction of the positive air pressure at inlet ports 14b of the wheel valves for effecting rapid movement of the wheel valve valving means to the closed positions of Figure 1. Without vent valve 86 in the system, back flow of air from the tires may maintain a sufficiently high positive pressure at inlet port 14a to delay closing of the valving means, thereby causing unwanted loss of tire pressure, increasing the time rotary seal assemblies are subjected to the deteriorating of pressurization and increasing the time required be effect sequences.

Figure 2 illustrates the valve positions during an inflation sequence which is terminated in the same manner as the pressure check sequence.

A tire deflation sequence is initiated by energizing valve 68,70 to the closed position and energizing vacuum source solenoid 80 to the open position to provide a negative air pressure at inlet ports 14b for moving the wheel valve valving means to positions connecting outlet ports 14a to exhaust ports 14c as illustrated in Figure 3. The deflation sequence is terminated by de-energizing vacuum source solenoid valve 80 to the closed position.

Wheel Valve Assembly 14

Wheel valve assembly 14 comprises a housing including a housing body 96 and a housing cover 98, the inlet, outlet and exhaust ports, a first diaphragm valve device 100 operative to allow and prevent air communication between the inlet and outlet ports, a second diaphragm valve device 102 operative to allow and prevent air communication between the outlet and exhaust ports, a third valve device 104 for restricting air flow from the outlet port to the inlet port, and a manual fill valve 106 for manually increasing/decreasing air pressure to the tire or tires connected to the outlet of each to the wheel valve assembly. The housing body and cover are secured together by a plurality of fasteners 107.

First valve device 100 includes a flexible diaphragm 108 dividing a first cavity defined by the housing body and cover into a first pilot chamber 110 in continuous communication with the inlet port and a vented spring chamber 112, a valving member 108a defined by a center portion of the diaphragm, a valve seat 114 disposed at one end of a passage 116 communicating at its other end with the outlet port via a passage 118, a rigid cup shaped member 120 slidably disposed in spring chamber 112 and biased against the diaphragm by a spring 122. Spring 122 biases valve member 108a into a closed position or sealing engagement with valve seat 114 with a force sufficient to maintain the sealing engagement for the highest contemplated tire pressure. Valving member 108a

is moved to an open position against the force of spring 122 in response to a predetermined minimum positive air pressure in pilot chamber 110 from the inlet port acting on diaphragm surface 108b.

Second valve device 102 includes a flexible diaphragm 124 dividing a second cavity defined by the housing body and cover into a second pilot chamber 126 and an exhaust chamber 128, a valving member 124a defined by a center portion of diaphragm 124, a valve seat 130 disposed at one end of a passage 132 communicating at its other end with the outlet port, a rigid cup shaped member 134 slidably disposed in second pilot chamber 126 and biased against diaphragm 124 by a spring 136. Exhaust chamber 128 continuously communicates with atmosphere via passages 128a, 128b which extend on opposite sides of passage 118 to exhaust port 14c. A flexible cover assembly 138, prevents entry of foreign matter into the exhaust port. As seen in Figure 8, passages 128a, 128b have a somewhat crescent shape. Passage 128a is indicated by phantom lines in Figure 7. Exhaust chamber 128 also is in continuous communication with spring chamber 112 of the first valve device via a somewhat Z-shaped passage 140. With reference to Figure 6, second pilot chamber 126 is in continuous communication with the inlet port via a passage 142 shown in phantom lines. An end 142 of the passage opens into chamber 126 and an end 142b opens in to the inlet port. Spring 136 biases valve member 124a into a closed position or sealing engagement with valve seat 130 with a force sufficient to maintain the sealing engagement for the highest contemplated tire pressure. Valving member 124a is moved to an open position against force of spring 136 in response to a predetermined minimum negative pressure from the inlet port acting on diaphragm surface 124b.

Third valve device 104, which may be structurally of many different designs, is disposed in series between first valve device 100 and the outlet port. Device 104, as seen in Figures 7 and 7A, includes a valving member 144 having an open or first position, as shown in Figure 7, which allows substantially unrestricted flow of air from the inlet port to the outlet port, and having a partially closed or second position which allows only restricted flow of air from the outlet to the inlet. Valving member 144 includes a rectangular portion 144a having a plurality of guide legs 144b extending therefrom at right angles, and a circular valve seat 146 disposed at the adjacent end of passage 116 for cooperating surfaces at the corners of the rectangular portion. Legs 144b are slidably received in guide recesses 148a in a well 148 of diameter greater than rectangular portion 144a to allow free flow therearound to passage 118. When air flow is from the outlet port to the inlet port, as may occur during a pressure check sequence and/or when air control circuit 40 is being vented to atmosphere for closing valve device 100, the flow of air around valving member 144 moves the valving member into contact with valve seat 146 such that a plurality of small through passages 148 are formed to allow restricted air communication between the inlet and outlet port while the first valve device is open. Small passage 148 ensures sufficient air communication between the inlet and outlet ports for rapid pressure equalization of tire pressure in conduit assembly 74 for accurate pressure check reading. The small through passages also restrict air flow from the outlet port to the inlet port during venting of air control circuit 40 to ensure rapid positive pressure drop in the first pilot chamber for effecting quick closing of the first valve device.

A preferred embodiment of the invention has been disclosed for illustrative purposes. Many variations and modifcations of the preferred embodiment are believed to be within the spirit of the invention. The following claims are intended to cover the inventive portions of the preferred embodiment and variations and modifications within the spirit of the invention.

Claims

1. A system (10) for monitoring and controlling air pressure in a tire (28) of a vehicle (12); the system comprising:

   an air control circuit (40) including a pressure source (42) and a vacuum source (44) respectively for providing positive and negative air pressures relative to an ambient air pressure, pressure and vacuum control valves (62,64) each selectively movable from a closed position to an open position for respectively connecting conduit means (74) with the positive air pressure via a pressure passage (56a) interposed between the pressure source (42) and the pressure control valve (62) and with the negative air pressure via a vacuum passage (84) interposed between the vacuum source (44) and the vacuum control valve (64);

   at least one wheel assembly (30,32) rotatably mounted on an axle assembly (34) and a tire chamber (28a) defined by a tire (28) mounted on the wheel assembly;

   a rotary seal assembly (16) for communicating the positive and negative air pressures from a non-rotatable port (16b) thereof connected to the conduit means (74) to a rotatable port (16a) thereof;

   a wheel valve assembly (14) having a housing (96,98) affixed for rotation with the wheel assembly (30,32) and including an inlet port (14b) and an outlet port (14a), an exhaust port (14c), a first valving means (108a) for allowing and preventing air communication between

the inlet and outlet ports (14b,14a) in response respectively to the presence and absence of positive air pressure at the inlet port (14b), a second valving means (124a) for allowing and preventing air communication between the outlet and exhaust ports (14a,14c) in response respectively to the presence and absence of negative air pressure at the inlet port (14b); and

a one-way vent valve (86) for effecting rapid venting of positive air pressure in the conduit means (74), the vent valve (86) including an inlet communicating with the vacuum passage (44), an outlet communicating with the ambient air pressure, a vent valving member (88) operative to block venting communication between the vent valve inlet and outlet in response to negative air pressure in the vacuum passage (84) and operative to allow such venting communication in response to the open position of the vacuum control valve (64) during the presence of positive air pressure in the conduit means (74).

2. The system of claim 1, wherein:

the wheel valve assembly (14) includes a third valve device (104) in the housing (96,98) disposed in series between the first valving means (108a) and the outlet port (14a), the third valve device (104) including a third valving means (144) movable between first and second positions during the open position of the first valving means (108a), the first position for allowing substantially unrestricted air flow from the inlet port (14b) to the outlet port (14a), and the second position for allowing only restricted flow of fluid from the outlet port (14a) to the inlet port (14b).

3. The system of claim 2, wherein:

the third valve device (104) includes third valve seat surface means (146) disengaged and engaged by surface means (144a) of the third valving means (144) in response to the first and second positions respectively of the third valving means (144).

4. The system of claim 3, wherein:

the surface means (144a) of the third valving means (144) and the third valve seat (146), when engaged, define at least one through passage for allowing said restricted flow of fluid from the outlet port (14a) to the inlet port (14b).

5. The system of claim 2, wherein the wheel valve assembly includes:

a first valve device (100) includes a first flexible diaphragm (108) having the first valving means (108a) affixed thereto and dividing a first cavity into a first pilot chamber (110) in continuous communication with the inlet port (14b) and into a spring chamber (112), a first spring means (122) disposed in the spring chamber (112) and biasing the first valving means (108a) affixed to the diaphragm (108) into a sealing relation with a first valve seat (114) disposed at an end of a first passage (116) for communicating the first pilot chamber (110) with the outlet port (14a); and

a second valve device (102) includes a second flexible diaphragm (124) having the second valving means (124a) affixed thereto and dividing a second cavity into a second pilot chamber (126) in continuous communication with the inlet port (114b) and into an exhaust chamber (128) in continuous communication with the exhaust port (114c), a second spring means (136) disposed in the second pilot chamber (126) and biasing the second valving means (124a) affixed to the second diaphragm (124) into a sealing relation with a second valve seat (130) disposed at an end of a second passage (132) for communicating the exhaust chamber (114c) with the outlet port (14a).

6. The valve assembly of claim 5, wherein:

the third valve device (104) includes third valve seat surface means (146) disposed at another end of the first passage (116) for disengagement and engagement with surface means (144a) of the third valving means (144) in response to the first and second positions respectively of the third valving means (144).

7. The valve assembly of claim 6, wherein:

the surface means (144a) of the third valving means (144) and the third valve seat (146) when engaged define at least one through passage for allowing said restricted flow of fluid from the outlet port (14a) to the inlet port (14b).

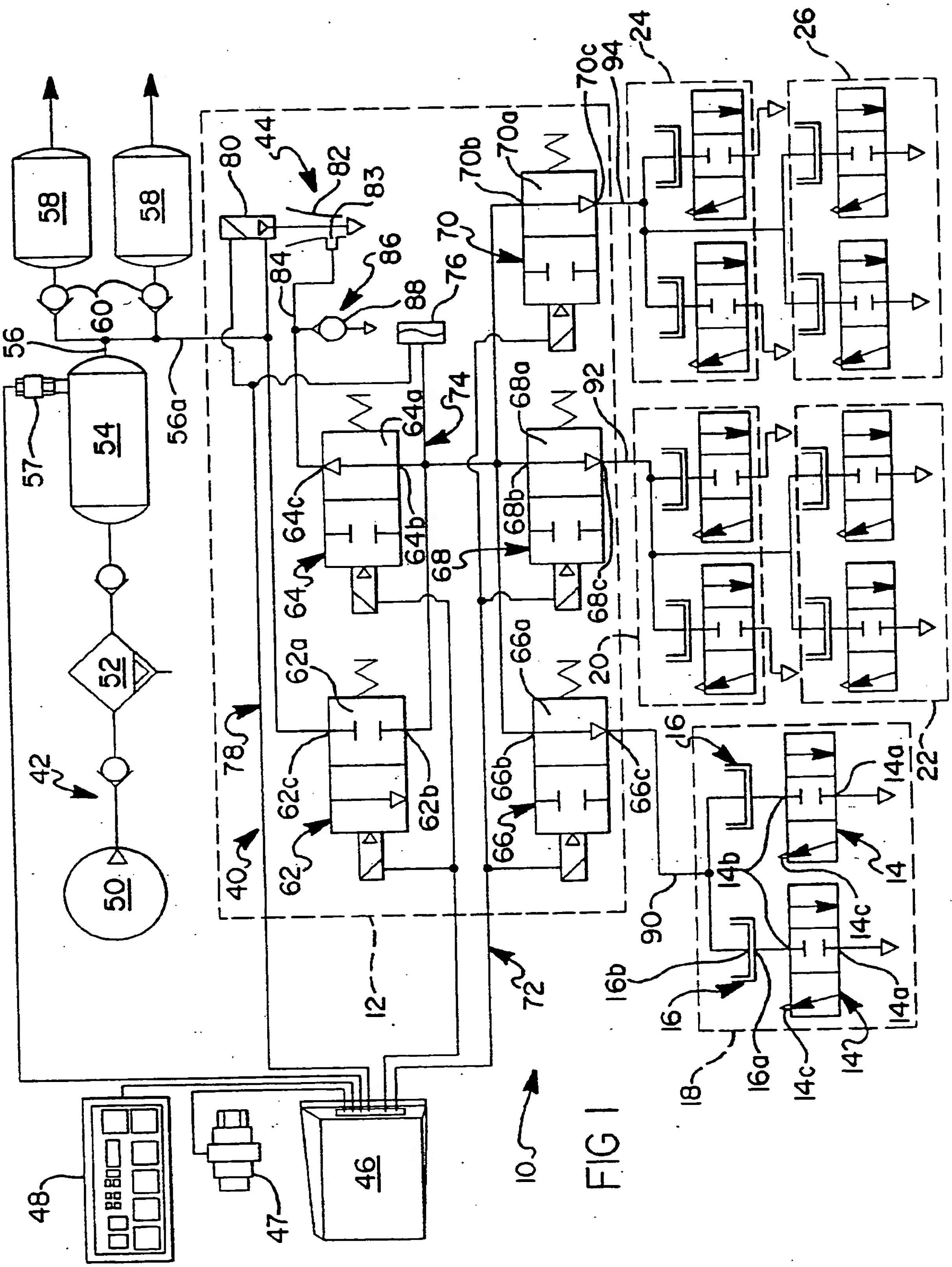
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FIG 1

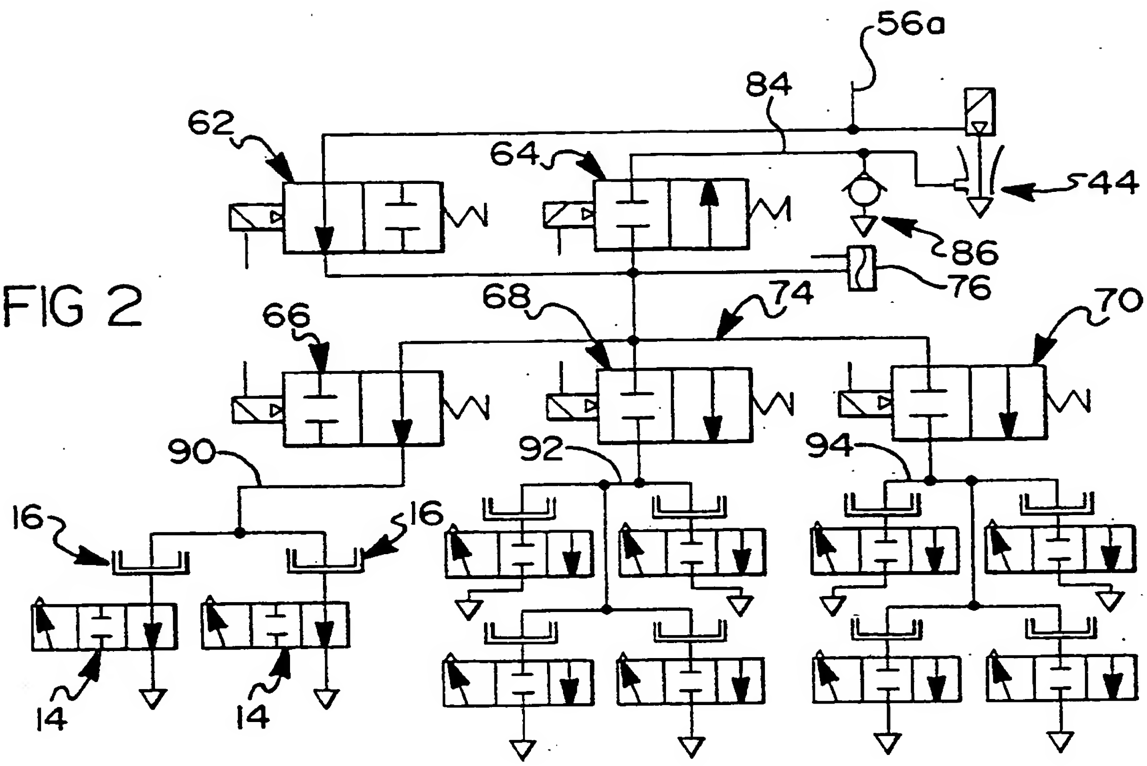
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FIG 2

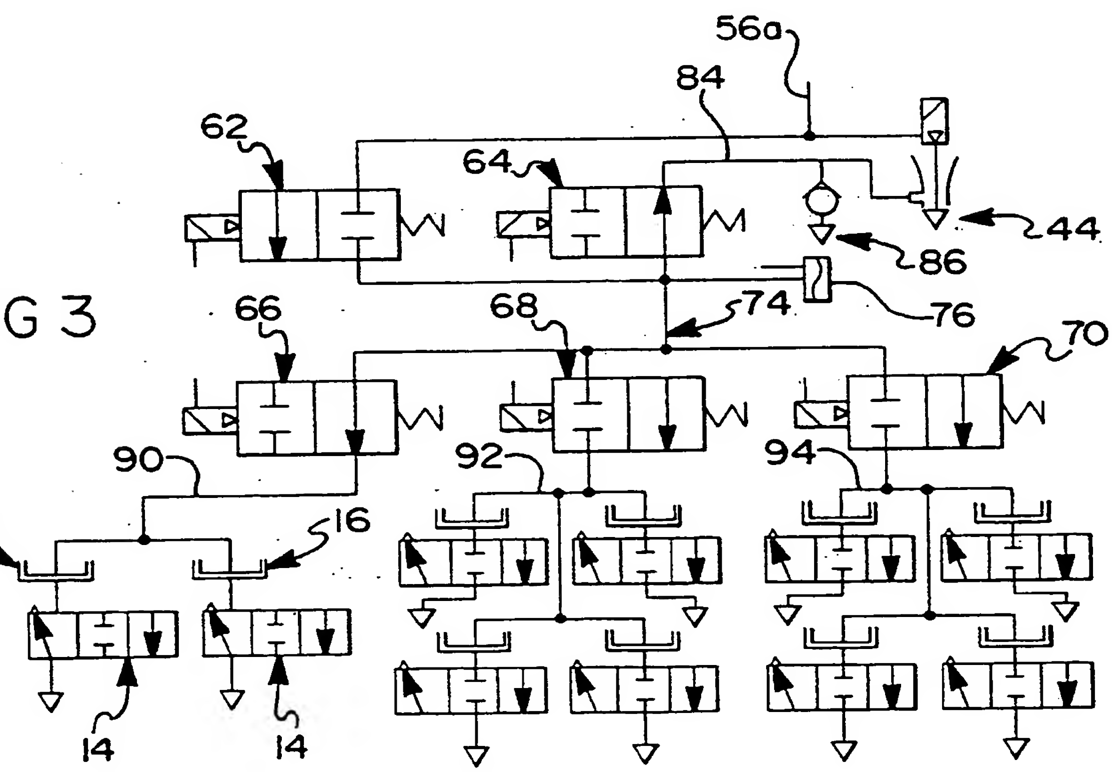
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FIG 3

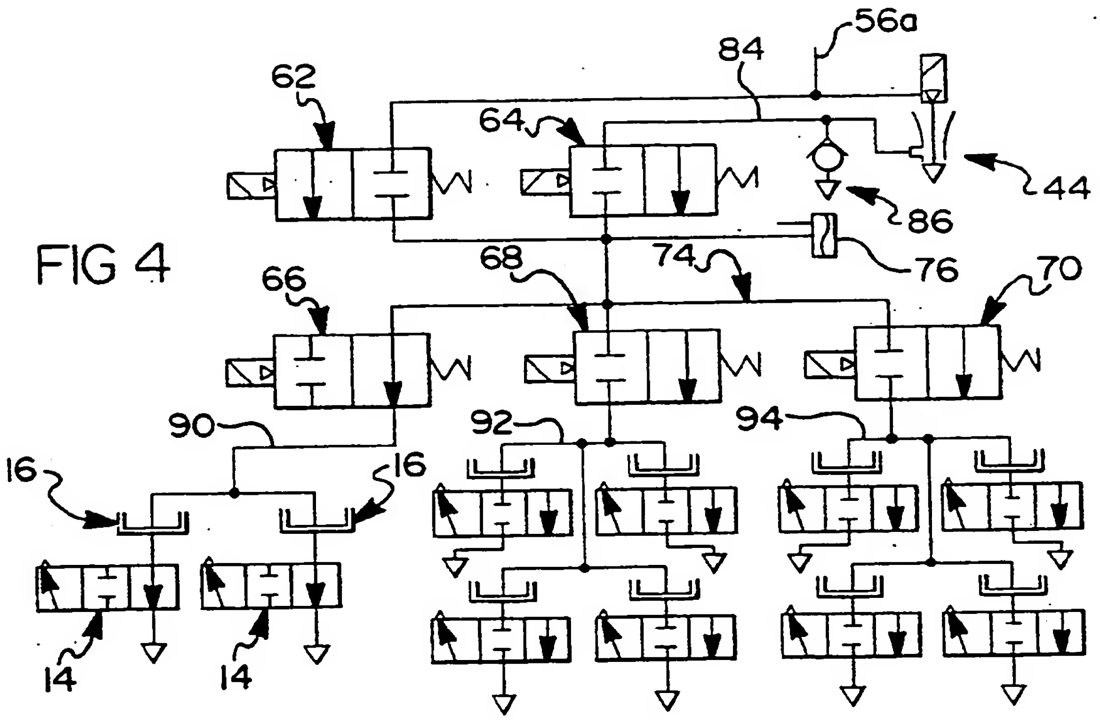

FIG 4

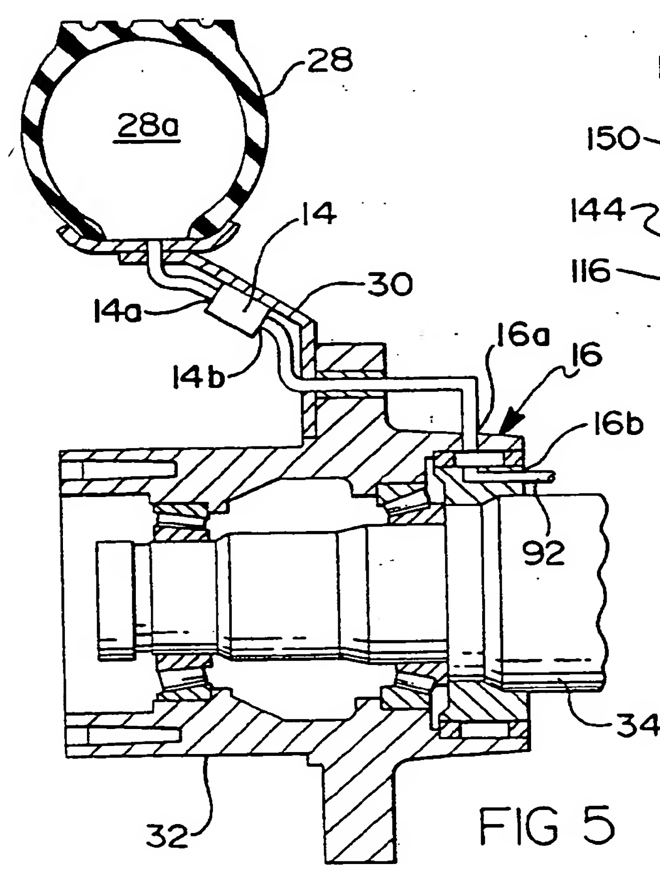

FIG 5

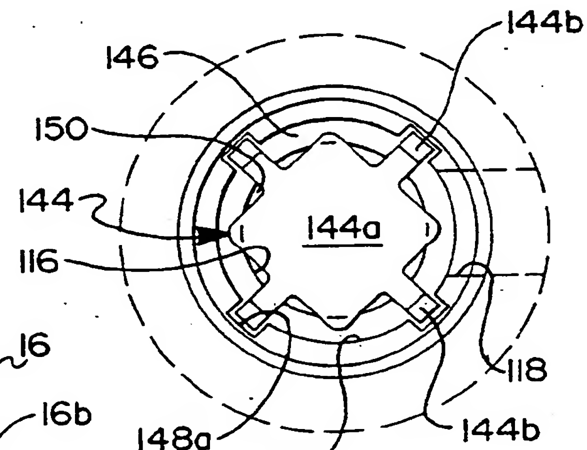

FIG 8

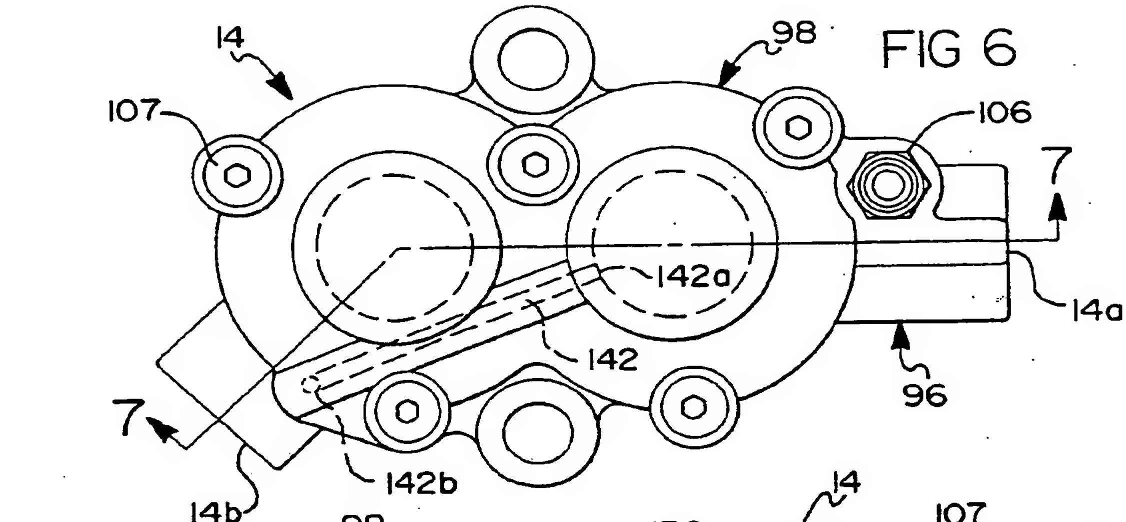

FIG 6

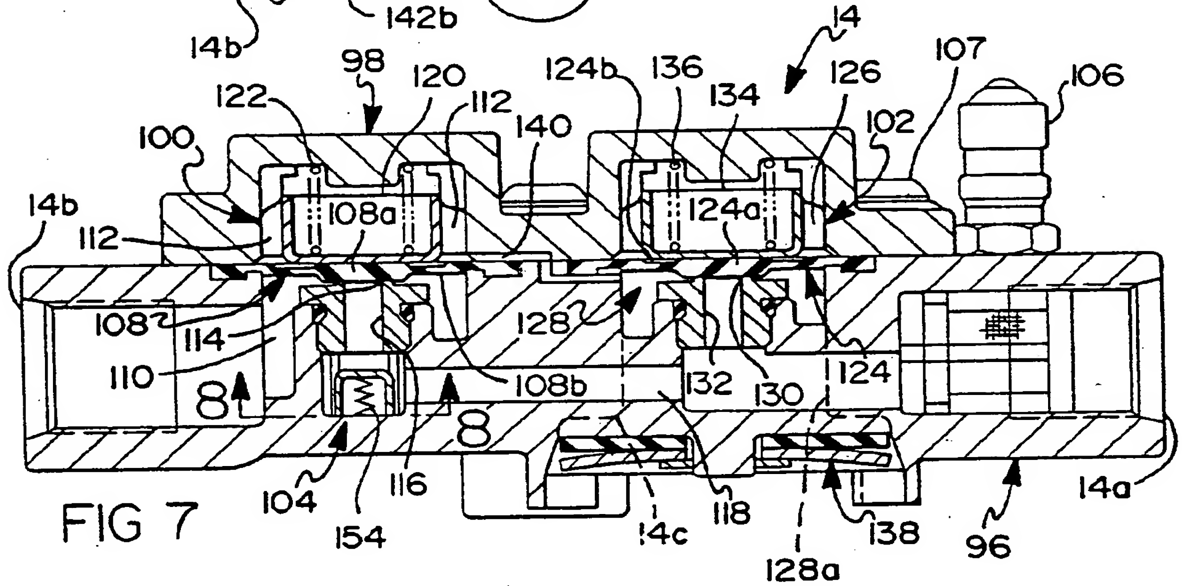

FIG 7

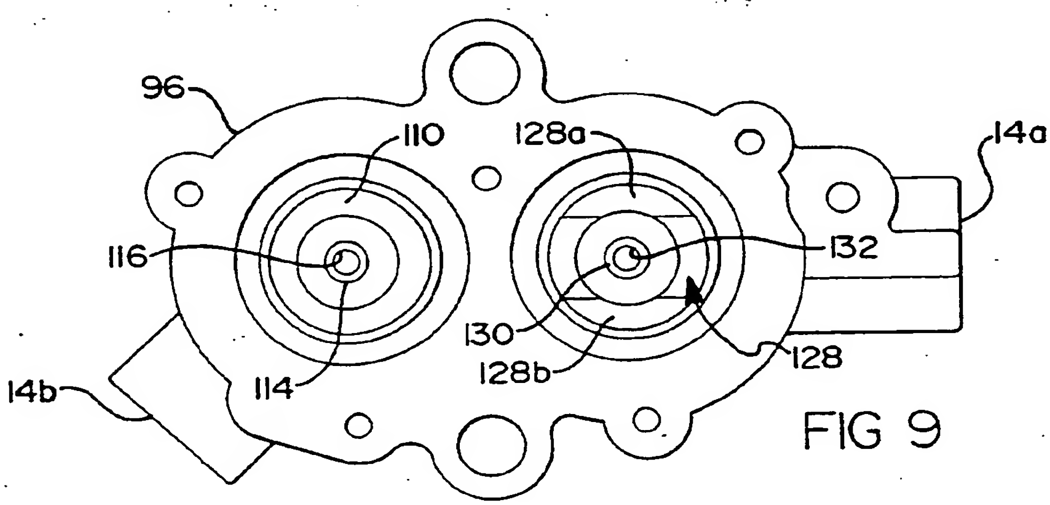

FIG 9

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(54) Vent for vehicle tire inflation system.

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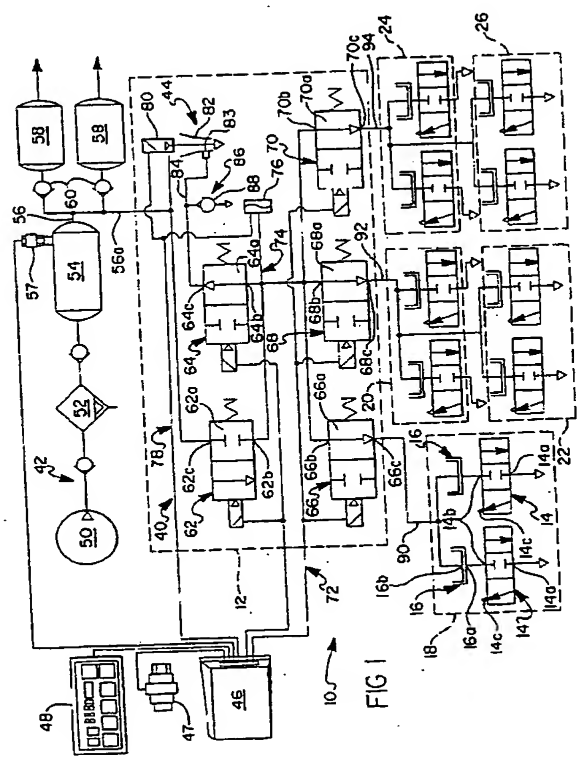

FIG 1

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EUROPEAN SEARCH REPORT

Application Number
EP 92 30 7875

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	EP-A-0 246 953 (ETAT-FRANCAIS) * column 5, line 51 - column 7, line 55; figures *	1,5	B60C23/00
A	EP-A-0 387 495 (WABCO) * column 6, line 14 - line 40; figure *	2-4	
A	DE-A-33 17 810 (WABCO) * page 10, last paragraph - page 11, line 18; figure *	2	
A	US-A-4 765 385 (NUMATICS) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

B60C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 November 1993	HAGEMAN, M

CATEGORY OF CITED DOCUMENTS

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